Prehistoric Implements in the Transvaal and Orange River Colony.

THE reason for writing these short notes is the desire to point out to those with the requisite knowledge the places where what are probably palæolithic remains can be found in South Africa. I am not able to dilate on the technical side of the question, having only a smattering of the subject.

Being a volunteer in the British Army, the immense distances covered by us gave one an opportunity of seeing a larger tract of country than would be possible as a civilian. Unfortunately, in South Africa the amount of systematic research into the subject of prehistoric weapons has been but small, and I think the Orange River Colony and the Transvaal would be found very rich in all such remains. The heavy rains and nature of the country allow many glimpses of the geological formations, and the dongas and dry river banks will nearly always reveal some old "drift." The nature of our marching did not allow us to go far from the beaten road, but a few worked stones could be picked up in every day's march.

Starting at Sterkstroom, with the 3rd Division, such specimens can be found all round the town of about 2 inches in length in a fair state of preservation, some few showing the effect of being water-worn. At a coal mine named Wallsend, the hill where we camped is simply covered with scrapers and chips; in fact I collected quite a dozen in the small circle covered by our bell tent. Further north, at Bethulie Bridge, they are lying in the subsoil of the river bank, as well as in the stony reaches of the river. Springfontein, Smithfield, Dewetsdorp, in fact right up to Bloemfontein, the country is covered with stones all about the same size, roughly chipped and, in all probability, of palæolithic origin. They are of the leaf form and vary from 1 to 2½ inches in length.

At the Vaal River they were more water-worn and larger, about 5 by 2 inches. Better specimens could probably be obtained by examining the drift, which I myself had no opportunity of doing. I found only two or three specimens round about Pretoria. Middleburg and Belfast were the last two places I was in, and in the former an immense quantity of implements can be picked up in the river bed and in the subsoil adjoining. They are of the large size, as those in the Vaal River, some which I found being about 5 by 5 inches and quite 1 inch thick.

Unfortunately, Army regulations as to the weight of kit had to be carried out, and I had three separate times to throw my collection away. I had kept the best specimens and ticketed them, but in the end I found myself discharged from the Army as a time-expired volunteer in Cape Town, with only three or four dilapidated specimens from Belfast.

If regulars and volunteers would write about their observations of other parts of the country covered by them it would indicate at a glance the richest places where a systematic research could be undertaken with the best possible results.

Sunderland. STANLEY B. HUTT.

The Age of the Woburn Abbey Musk-Ox.

IN the notice of the young musk-ox at Woburn Abbey which appeared in NATURE of May 16 it was stated that the animal was considerably more than two years of age when the photograph was taken. This age was assigned on account of a statement made by Dr. Allen in his recent memoir on the Greenland and American musk-oxen that the Woburn specimens must have been yearlings when they were first photographed in 1899. His reason for making that statement were that a young calf captured at Fort Conder in May, 1899, had a black face, instead of the white-spotted faces of the Woburn animals; and that the latter had consequently changed their coats. Now the Woburn specimens were captured on Clavering Island on August 16 of that year, and from information that has recently been supplied to me it seems almost certain that they were calves of that year, probably born the preceding April or May. If this be so, and if calves have black faces when first born, it would seem that the Woburn specimens had already changed their first coats when shipped for England during the late summer, a photograph of them having been taken on board ship showing the white faces. It thus appears that when the photograph reproduced in NATURE was taken, the animal was not more than two years old, and possibly rather less.

R. LYDEKKER.

The Subjective Lowering of Pitch.

As a general rule, the pitch of a musical note does not in any way depend upon its intensity, but solely upon the wave-length. It appears probable, however, that any wave motion of very great intensity produces distorted effects. Thus we find that a very loud sound may so affect the ear of the observer as to appear flatter than it really is. This is a purely subjective effect.

Dr. Burton was, I believe, the first to investigate the phenomenon, and some of his results (together with his explanation of them) will be found in vol. xiii. of the *Proceedings* of the Physical Society. My own attention was first drawn to the matter by observing what appeared to be the false intonation of certain singers upon loud notes, either when I was conducting near those singers or when I was rehearsing in a small room. Reading then of Dr. Burton's researches, I was led to investigate them for myself.

The subjective lowering of pitch is an undoubted fact, *i.e.* a very loud note does appear flatter than it really is.

If a C tuning-fork (middle C, 256 vibrations per second) be *strongly* bowed, and then be quickly brought near the ear, before its loud note has had time to die away, the sound will appear flattened to about B♭$_1$, or even A$_1$, the amount of the effect being different to different ears.

It is more difficult to obtain the effect with higher forks; indeed, a C^1 fork (512) must be bowed very strongly indeed to give the effect at all. An E fork (320) appears to give a flat D♯, and a G fork (384) gives F♯.

The effect is a subjective one, caused by great intensity, for it vanishes as the sound gets softer, and can then be restored by bringing the fork nearer the ear, thus again increasing the intensity. In this last case the restoration of effect is sudden, and is not due to any gradual movement of the fork (Doppler's principle).

If the position of the source of sound be fixed, the subjective note gets sharper as the intensity of the vibrations gets less; for instance, an E fork (320), when very strongly bowed, gave C♯ as its subjective note; but, as the vibrations died down, this C♯ varied to D, then became E♭, and finally and suddenly stopped altogether.

The amount of the subjective effect differs with different individuals, both in pitch and in intensity. What to one person appears a flattening of a minor 3rd, to another auditor appears a flattening of only a major 2nd, but in every case it appears to be a flattening and not a sharpening. Also the loudness of the subjective note appears different, even to the different ears of the same person.

In the case of some organ-pipes tested, the following results were obtained:—

C pipe (open, 256) gave A$_1$ as subjective.
E pipe (open, 320) gave D as subjective.
G pipe (open, 384) gave F♯ as subjective.
C^1 pipe (open, 512) gave B as subjective.

If an ear-trumpet be used, a very loud source of sound is not necessary in order to obtain subjective effects. If the source of sound be placed at a distance just great enough to prevent subjective flattening, and then an ear-trumpet be used, the subjective note at once appears.

Much of my own musical work has been done amongst male voices, and I have frequently noticed that a singer of good concert-room power may, if practising in a small room, seemingly sing with flat intonation. I should be glad to have further experience concerning this from your contributors, who will also, I hope, have noticed the effect in the case of brass instruments.

E. HURREN HARDING.

Normal College, Bangor, May 15.

RECENT STUDIES OF OLD ITALIAN VOLCANOES.

THE abundant and well-preserved extinct volcanoes of Italy have long had a great fascination for students of geology. So many allusions to them are scattered through the literature of the science, and so many accounts of them, more or less brief, have been furnished by those who have visited them, that their general characters and the more important varieties of their rocks are now tolerably familiar. But until lately hardly any of them have been subjected to that minute dissection which modern vulcanology and petrography now demand. The Italian geologists, however, have at last taken up the investigation in considerable detail, and are issuing excellent maps and monographs of different volcanic districts, which well deserve the careful attention of all who take an interest in the progress of volcanic geology. To some of the latest of these publications a brief reference may here be made.

The Italian Geological Survey has entered upon the study of the volcanoes of Central Italy and their products, and as a commencement has issued a detailed account of that remarkable volcanic centre which forms the group of the Alban Hills to the east of Rome. This work has been accomplished by one of the staff, Mr. V. Sabatini, who has long been known for his geological enthusiasm.[1] It forms a volume of nearly 400 pages, with an excellent map of the region, ten plates of views and petrographical sections and 79 figures inserted in the text. After a brief introduction devoted to a discussion of some of the theoretical principles involved in the interpretation of volcanic phenomena, the author proceeds to give a sketch of the topography of the region and of the position of its several eruptive vents. He recognises, as at Vesuvius, the records of two great periods in the volcanic history. The first, one of conspicuous vigour, which built up a large cone that was finally demolished by a stupendous explosion; the second, one of minor force, whereby a cone was formed within the original circuit. Each of these phases has been attended with the production of secondary or adventitious cones, and the author endeavours to trace a series of lines of fissure along which, in his opinion, these cones have been produced. It is to be noted that some of his lines appear to rest merely on the evidence of carbonated or sulphurous springs, and even where they run from cone to cone some effort of imagination is needed to picture the lines of fissure as he gives them. In Southern Italy the geologists are less fanciful in dealing with the unseen substructure of their volcanoes.

The second chapter treats of the various hypotheses which have been proposed in explanation of the origin of the Roman Campagna and the Alban Hills, and especially of the tuffs so widely developed in that region. A detailed description of these tuffs is given ; they are classified as lithoid, homogeneous, granular, pumiceous and earthy, and reference is made to the terrestrial flora and fauna enclosed in them. Their plants include many familiar living species. On Monte Celio, land-shells were found ; on Monte Verde, the molluscs were of fresh-water species; in the tuffs between Nettuno and Astura, Meli has collected a considerable number of marine and estuarine forms, while a large assemblage of bryozoans has been gathered from the volcanic tuffs of Anzio and Nettuno. The succession of the different varieties of tuff is next given as displayed in many sections in and around Rome, and an attempt is made to estimate the cubic contents of the vast sheet of tuff which has been discharged from the Vulcano Laziale.

The third chapter deals with the nature and classification of the Latian lavas. These are grouped into normal leucitites and leucotephrites. The alterations which they have suffered are described, such as the transformation of leucite into felspar. Detailed descriptions are then given, in chapters iv. and v., of the rocks of each important part of the outer and inner cones of the volcano, and the author, following a practice for which he no doubt can cite high authority, adopts a somewhat complicated and cumbrous system of symbols to express the petrographical characters of each rock. Such a system may be convenient, especially where rapid comparisons of different species and varieties of rocks are desired by a student who has taken the time and labour necessary to understand it and commit it to memory But life is too short and geological literature is too long for such a task on the part of ordinary readers. · It would not have cost much more type to have accompanied the symbols with a brief statement of the composition of the rocks in plain language. The origin and constitution of the craters of Nemi, Castel Gandolfo and Ariccia take up the next three chapters. The author here, as in the rest of the volume, deals less fully with the tectonic than with the petrographical part of his subject. He would have added much to the geological interest of his memoir had he given more ample details of the structure of the great volcano and presented a clear and vivid outline of the whole succession of volcanic phenomena of which it preserves the record. Perhaps he may intend to deal with these parts of his subject in a subsequent treatise. A useful bibliography is appended to the volume. It is much to be desired, however, that precise references had always been given to the passages in the works of the authors whose names are cited in the text. The continuation of the important research of which Mr. Sabatini gives here the first instalment will be awaited with much interest.

In Southern Italy the investigation of volcanic phenomena is naturally incited by the irresistible attractions of the active volcanoes of that region. The study of the extinct cones and craters, however, has perhaps rather been retarded by the abundant opportunities offered there of witnessing the actual progress of eruptions. Within the last few years the subject of the older volcanoes has been taken up by several observers, who, without the resources of the National Survey to assist them, have nevertheless been successful in bringing much fresh information to light. Two of these geologists—Prof. G. de Lorenzo, of the University of Naples, and Prof. C. Riva, of the University of Pavia—deserve especial commendation for the enthusiasm of their researches. The volume just issued of the *Transactions* of the Royal Academy of Naples contains two detailed memoirs, one by Prof. G. de Lorenzo on the well-known Monte Vulture between Naples and the Adriatic, the other by the two authors conjointly on the seldom-visited crater-island of Vivàra between the islands of Ischia and Procida in the Bay of Naples.[1]

The memoir on Monte Vulture extends to 207 closely printed quarto pages, and is illustrated by numerous figures in the text as well as a map and a number of excellent plates in photogravure, of which one is here reproduced. In an introduction, the history of observation regarding this ancient volcano is briefly sketched. The author then proceeds to describe the various sedimentary series through which the volcanic explosions took place. These consist of Trias, Cretaceous, Eocene and Miocene formations, together with Pliocene and Pleistocene deposits both marine and terrestrial. The stratigraphical relations of these various groups of strata had already been discussed by M. de Lorenzo in a paper on the geology of the Southern Apennines, published in 1896, and they are well displayed in a plate of sections accompanying the present monograph. The incomplete series of Mesozoic formations is shown to have been considerably disturbed before Tertiary time, while the Eocene and Miocene deposits had likewise been plicated and denuded before the Pliocene strata were laid down upon them. In the southern outskirts of the mountain the volcanic pile rests on the younger Tertiary groups, while towards the north it spreads over the area of the Eocene and Miocene "Flysch." The faulted nature of the ground is well shown in some of the illustrations, but the author does not believe that Monte Vulture has had its site determined by the stupendous linear fracture which some theorists have imagined to extend eastwards from Vesuvius. He has satisfied himself, by a study of the geological structure of the surrounding country, that no trace of any such dominant dislocation exists.

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[1] I vulcani dell' Italia Centrale e i loro Prodotti. Parte Prima—Vulcano Laziale, di V. Sabatini. Roma, 1900. (R. Ufficio Geologico. Memorie Descrittive della Carta Geologica d' Italia, vol. x.). This volume, the author informs us, is based on the work of 112 days in the field and the examination of 400 microscopic slides of rocks. The volcanic centre here referred to under the name of "Vulcano Laziale" comprises the Monti Laziali and the Monti Albani and their surroundings.

[1] "Atti della Reale Accademia delle Scienze Fisische e Matematiche di Napoli," second series, vol. x. 1901.

The various rocks of the volcanic pile are then described in some detail. They are shown to form a numerous and continuous series of varieties between the two extreme limits of trachytoid phonolites, on the one hand, and basalts on the other. The principal types of lava are thus arranged: Hauyne-phonolite, anorthoclase-phonolite, hauyne-tephrite, leuco-hauyne-tephrite, leuco-hauyne-basanite, leucitic basalt, leucitite, nephelinite, hauynophyre. Each of these types is fully described and is illustrated by excellent plates of its microscopic structure. A section is devoted to the characters of the agglomerates by which the lavas are accompanied, and another to the inclusions contained both in the lavas and the fragmental materials, some of which were doubtless derived from the underlying sedimentary platform, others probably represent portions of the subterranean magma which have acquired a granitoid structure at a great depth, while in some cases their origin is doubtful.

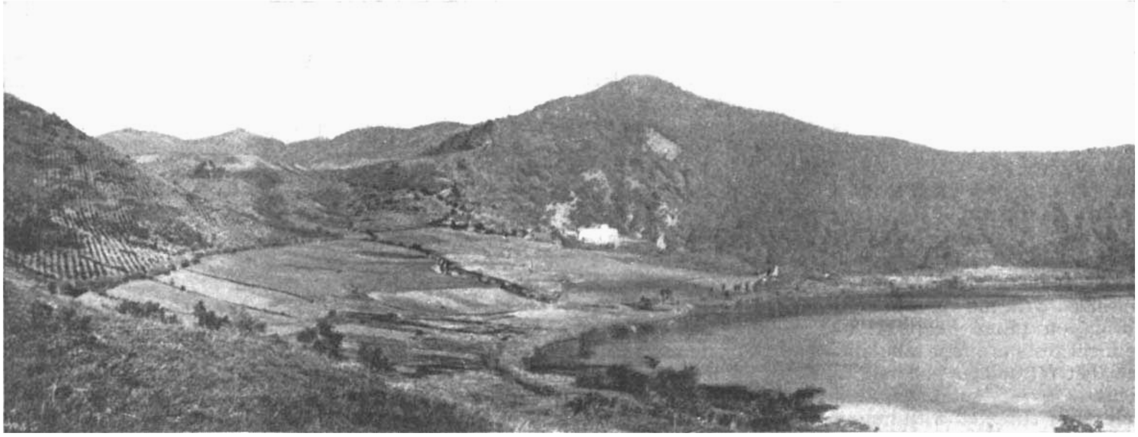

FIG. 1.—View of the interior of Monte Vulture, showing the great exterior rampart and the crater lakes of Monticchio.

Having described the materials of the volcanic pile the author next furnishes an account of the way in which they have been built up into the huge mass of Monte Vulture. In a long and interesting section of the paper the structure and probable history of the mountain are discussed, and the position of its various rocks and some of the successive phases in the evolution of the topography are explained in diagrams inserted in the text. The next division treats of the lakes which, partly in consequence of the volcanic disturbances, were formed in some number and of considerable size during Pleistocene time. This subject had already been treated by M. de Lorenzo in a separate memoir (*Atti Accad. Scien. Napoli*, 1898) in which he had shown that Southern Italy in Quaternary time was dotted over with large and small basins of fresh water. Whether formed in consequence of changes in the topography produced by the volcanic eruptions or existing before these eruptions began, the lakes around Monte Vulture were more or less filled up with limno-volcanic tuffs containing fresh-water shells and likewise remains of *Elephas antiquus*, *Hippopotamus major*, *Ursus spelaeus*, *Felis spelaea*, *Hyena spelaea* and *Cervus elephas*.

In a final section the author states what he believes to be the bearing of the history of Monte Vulture on theoretical questions of volcanism. He insists on the total independence of the eruptions of this centre, which he thinks had no direct communication with those of any other. He can find no trace of the great connecting fissures which have been supposed to link together all the old and modern volcanoes of Southern Italy. He regards the eruptions of this centre as having begun long after the great orogenic movements that gave rise to the Apennine chain, and at a time when perennial snows and glaciers still lingered on the surrounding heights. Phonolitic lavas first made their appearance, followed by tephrites, basanites and basalts, which form the great mass of the mountain. Two peripheral vents can be distinguished, one anterior, the other posterior to the formation of the great central cone. The last stupendous manifestation of volcanic energy seems to have been the explosion which blew out the great crater in which the two crater-lakes of Monticchio now lie (Fig. 1).

M. de Lorenzo acknowledges the important services rendered to him by his friend Prof. Riva—the young and accomplished mineralogist of Pavia whose petrographical assistance and photographic skill were freely given in the preparation of this important monograph. The other memoir above cited is a joint production of the two observers. It is entitled "Il Cratere di Vivàra nelle Isole Flegree," and forms No. 8 in the same volume of the *Transactions* of the Naples Academy. It begins with an interesting historical introduction and then at once enters on a discussion of the rocks of which the remarkable island is composed. These consist entirely of fragmentary materials which have been heaped up around a crater, as in the other volcanic cones of the Campi Phlegræi. A careful account is first given of the coarse breccias or agglomerates, which include blocks of trachytic obsidian, sanidinites with quartz and catoforite, anorthoclase-trachytes with ægirine, augitic trachytes, mica-trachytes, andesitic trachytes, basalts, trachydolerites, rocks of dioritic type (monzonites) and other varieties. Full petrographical descriptions of these rocks, together with micro-photographs of their internal structure, are given. The varieties of pumice, lapilli and tuff are likewise detailed. It is shown that the eruptions of Vivàra, unlike those of the neighbouring region, did not consist solely of trachytic material, but discharged an admixture of a trachytic and a basaltic magma, so as to have heaped up a rich assortment of the most remarkable rocks, beginning with a quartziferous sanidinite and passing through various trachytic types to normal olivine-basalt. The relations of these rocks to the other similar materials in the Phlegræan region are next discussed, and the authors then pass to the structure of the island, which they show to consist of successive sheets or banks of ejected fragmentary volcanic material without any accompanying lavas, and disposed in the usual divergent arrangement, the portions on the outer surface of the cone dipping steeply outwards into the sea, while those on the inside are inclined towards the centre of the crater. Vivàra rises out of the Mediterranean as a truncated cone which attains a height of 109 metres and a diameter across its upper rim of about 900 metres. The eastern half of the cone has been broken down and the sea now fills the circular crater. The waves and rains have cut many sections of the rocks, and thus the structure of the old volcano has been admirably dissected. All students of vulcanology will welcome these memoirs and hope that they may be regarded as the precursors of a long series in which the volcanic history of Southern Italy will be thoroughly elucidated.

ARCH. GEIKIE.

AGRICULTURE IN NEW SOUTH WALES.

THE *Agricultural Gazette* of New South Wales has ushered in the century, and, at the same time, marked the consummation of an Australian Commonwealth, by issuing a special federal edition. The history of the agricultural development of the Colony is dealt with in most interesting fashion by the chief inspector of agriculture, Mr. W. S. Campbell, who, in the hundred and thirteen pages that he appropriates, unfolds a fascinating tale of the early struggles and final success of this offspring of Great Britain, whose birth dates from the year 1788.

In the section devoted to chemistry in relation to agriculture a considerable feature is made of the value to the agriculturist of soil-analysis. Expert advice in the treatment of soils is said to be much sought after by the farmers of New South Wales, and a typical report on a poor soil is inserted with the view of showing the form that the information takes. The results of the physical and chemical tests are first tabulated, and from these the soil specialist formulates the following recommendations :—

"This is a very sour soil, low in plant-food, and only moderately supplied with humus. Its retentive power for water is low, consequently its power of resisting drought. It will not give the best results till sweetened and brought into good condition. The treatment recommended is, first, liming at the rate of about one ton per acre. This will sweeten the soil, and supply lime in which the soil is deficient. Then a quick-growing crop, such as vetches, lupins, cow-pea, &c., should be grown and ploughed under when just maturing. This will supply vegetable matter, improve the texture, and supply nitrogen, in all of which essentials the soil is weak. After this treatment the soil should be able, with proper manuring, to grow any of the ordinary fruits suitable to the district, such as are mentioned in your letter. Peaches and stone fruit should do very well, as well as any vegetables. With regard to the most suitable manuring, this should be on the lines recommended in the attached departmental pamphlet, 'Formulæ for Fertilisers,' which gives the manuring required for the different crops in average soil. In your case the quantities recommended may be somewhat increased. I would particularly impress upon you, (1) That this report is intended to be merely suggestive, and must be followed up by careful experiments on your own part ; (2) . . . . (3) That you should impart to your neighbours any information you may gain from this report as freely as it is given to you ; (4) That you should communicate regularly with the Department as to the results of your experiments, for we have special facilities for advising you as to the best manures for your special needs, and the cheapest form in which you can get the same."

This typical report is reprinted almost in full in order to show what the Department of Agriculture of New South Wales professes to be able to do in one section of the farmer's business, namely, the management of his soil. Experience in other countries has shown that advice given in the light of laboratory tests on soil is apt to be rather uncertain in its results, but in Australia science has, in this respect, it is said, been very useful to farmers. The practice of liming in that country seems to vary considerably from what holds in England. Where sourness in soil is the trouble an English farmer would consider a dressing of five tons of lime per acre none too much, but in New South Wales one ton is recommended as the maximum dose, to be repeated, if need be, a few years later.

Not the least interesting section of this federal number is that which treats of agricultural education. Technical instruction in agriculture appears to be eminently practical, and it is noted with satisfaction "that among the large number of young people so trained there are to be found so great a proportion who have achieved signal success upon farms and orchards of their own." The curriculum at the Hawkesbury College is almost rigorous in its thoroughness. The students who are on dairy duty turn out at 4.15 a.m., and are probably ready for their breakfast, which is served at seven. The sixty-five horses and mules that cultivate the College farm of 1100 acres demand the attention of another "gang" of students, whose day's work does not close till 8 p.m. Hard manual work does not appear to discourage the young farmer of New South Wales in his pursuit of knowledge, the present accommodation of the College being inadequate to meet the demands for admission. Some illustrations of the practical character of the education are culled from the interesting volume before us, which reflects a colonial vitality most gratifying to the mother-country.

CLIMATE AND TIME AND MARS.

THE astronomical theory of an Ice Age, of which the foundation is attributed to Adhémar, has been the subject of much discussion. Its laborious exposition by Dr. Croll has been justly considered a work of great merit, but it may be said to have proved more interesting as a speculation than convincing as an argument. The adequacy of the theory to explain all that is required of it is a highly controversial matter, and was debated with no little heat in the columns of this journal in 1895-6. Consequently it is desirable to state that this note is written from the point of view of qualified belief in the argument as expounded by Sir R. Ball.

The contribution of astronomy to the data of the problem can be very easily stated. Let us consider the northern hemisphere of a planet, the eccentricity of whose orbit, e, is sensible, but so small that only its first power need be taken into account. In the first place the ratio of the total solar radiation received in summer and winter is $1+a : 1-a$, where $a = 2 \sin \omega/\pi$, ω being the obliquity of the equator to the orbit. This is the law discovered by Wiener, and in the case of the earth $a = \cdot 25$. The ratio of the duration of summer and winter, *i.e.* of the periods between the equinoxes, is $1+b : 1-b$, where $b = 4e \sin \lambda/\pi$, λ being the true anomaly of the spring equinox. Hence the ratio of the mean heat received in a given time in summer and winter is $(1+a)/(1+b) : (1-a)/(1-b)$. In the southern hemisphere the corresponding ratio is $(1+a)/(1-b) : (1-a)/(1+b)$. At the present time $b = \cdot 02$, but in circumstances which would cause the earth's eccentricity to reach its maximum value (about $\cdot 0747$), $b = \cdot 09$ when $\lambda = 90°$. Under such conditions, then, the southern winter would un-